REMARKS

This Amendment after Final is filed in response to the FINAL Office Action mailed August 6, 2010, and in response to the Advisory Action mailed September 9, 2010, and in response to the interview held with SPE Kevin Ellis on September 21, 2010. A Request for Continued Examination and the associated fee is also filed herewith. All objections and rejections are respectfully traversed.

Claims 1-16, 39-40, and 45-51 are in the case.

No new claims have been added.

Claims 1-2, 4-10, 12-16, 39-40 and 49-51 have been amended.

Interview Summary

Applicant would like to thank SPE Kevin Ellis for conducting the Applicant Initiated Interview on September 21, 2010 and for helping to advance this Application closer to allowance. Generally, the issue discussed involved overcoming rejections under 35 U.S.C. §112, paragraph 2. While Applicant does not necessarily agree with the Office Action's usage of the 35 U.S.C. §112, paragraph 2 rejections, Applicant discussed adding language sufficient to overcome the 35 U.S.C. §112, paragraph 2 rejections. All necessary support for the claim amendments may be found, at least in part, below. SPE Kevin Ellis noted that Applicant's claim amendment suggestions were sufficient to overcome the 35 U.S.C. §112, paragraph 2 rejections. Examiner is encouraged to contact the undersigned attorney with any questions.

Claim Support

Any currently pending claim(s) are believed to be in condition for allowance and fully supported by Applicant's specification, as may be shown at least by the exemplary citation(s) farther below. Upon request, additional citations may be provided for additional support.

> In one embodiment, the step of controlling the write operation to substantially minimize parity calculation cost includes the steps of examining the write operation; selecting whether to substantially minimize

the number of read blocks or to substantially maximize chain lengths of read blocks; and implementing the selection responsive to the block layout information. If the selection constitutes substantially minimizing the number of read blocks, then the write controlling step further includes the steps of determining on a stripe-by-stripe basis whether to calculate parity based on the subtraction method or the recalculation method and then performing any appropriate read operations to support the method selected and calculate parity. The determination is made by examining which calculation method would require the fewest read operations. On the other hand, if the selection constitutes substantially maximizing chain lengths of read blocks, then the write controlling step further includes the steps of deciding which storage blocks to read to substantially maximize chain length while minimizing the number of storage blocks read to support either the subtraction method or the recalculation method, and then perform read operations on those blocks and calculate parity. (4:26-5:16)

In yet another embodiment, the invention relates to a method for managing storage of data in a storage system including a plurality of storage devices each including a plurality of storage blocks. The method includes writing data to a group of storage blocks that include predetermined storage blocks across a plurality of stripes and predetermined storage blocks within each storage device. This is done in a manner that substantially maximizes chain length of storage blocks within each storage device while substantially minimizing the cost of calculation of error correction parameters for the plurality of stripes. In one embodiment, chain lengths are maximized for writes of data, and chain lengths are maximized for reads to support parity calculations. (6:3-16)

As used herein, in one embodiment, "chaining" is reading/writing data from/to a single I/O to contiguous blocks on a disk drive, i.e., blocks whose DBN are sequential. In other embodiments, chaining is reading/writing data in a single I/O from/to blocks that may not be contiguous, but are as proximate to one another as possible, recognizing that intervening storage blocks may already be allocated or otherwise unavailable to the I/O (also known as "locality").

"Chain length" means the number of blocks contained in a chain. "Maximizing chain length" is a process of achieving the longest possible chain length on a disk, which is limited to the number of storage blocks on the disk, but may also be limited to a reasonable lesser number, e.g., in order to avoid undue latency in assembly of chains or executing the I/O or due to limitations on the availability of resources necessary to perform the

I/O. Maximizing chain length can be performed for each disk separately or for all disks in combination over the entire array. (10:30-11:16)

A first methodology entails determining the fewest number of read operations on a per stripe basis required to effectuate the parity calculation, while still chaining together reads from the same storage device wherever possible in one method. In this case the array is examined to ascertain the number of storage blocks in each stripe that are to be written. (14:18-25)

A second methodology entails identifying which storage blocks to read to substantially maximize chain length while minimizing the number of blocks read and being able to calculate parity in all read stripes by either the subtraction method or the recalculation method. The parity calculation method (i.e., subtraction or recalculation) chosen are implemented so that the required read operations entail the longest chain lengths within the entire array without regard to the per stripe number of reads. (15:17-25)

Thus, for a disk bandwidth limited system that is not CPU or memory constrained, the RAID layer preferably maximizes chain lengths for reads required by the parity calculation by evaluating the block layout information prepared by the file system. To do this, in one embodiment, the RAID layer identifies various combinations of block chains on different disks, calculates for each combination an average or mean chain length, and specifies those blocks belonging to the combination having the longest average chain length as the ones to read during the read operation. Thus, maximizing chain length is performed for all disks in combination over the entire array. (16:17-28)

Rejections Under 35 U.S.C. §112

At paragraph 8 of the Office Action, claims 1-16, 39-40, 47-49, and 51 were rejected under 35 U.S.C. §112, paragraph 2. As noted above in the Interview Summary, Examiner Nguyen noted that Applicant's claim amendment suggestions were sufficient to overcome the 35 U.S.C. §112, paragraph 2 rejections. As such, claims 1-16, 39-40, 47-49, and 51 are believed to satisfy all requirements as set forth under 35 U.S.C. §112. Accordingly, claims 1-16, 39-40, 47-49, and 51 are believed to be in condition for allowance.

For completeness of the record, Applicant maintains the contentions discussed in the previous Amendment filed on May 28, 2010, however, in the interest of advancing prosecution and avoiding the delay in seeking appellate review from the Board of Patent Appeals and Interferences and/or the U.S. Court of Appeals for the Federal Circuit, Applicant has amended the claims noted above. Should the claim amendments not satisfy the Office, Applicant expressly reserves the right to present these contentions or variations thereof in any appellate procedures.

Allowable Subject Matter

At paragraphs 15-16 of the Office Action, claims 45, 46, and 50 are allowed, and claims 1-16, 39-40, 47-49, and 51 would be allowable if amended to overcome the above-referenced §112, second paragraph rejections.

Conclusion

All amendments are believed to be fully supported by Applicant's specification.

All independent claims are believed to be in condition for allowance.

All dependent claims are believed to be dependent from allowable independent claims, and therefore in condition for allowance.

Favorable action is respectfully solicited.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

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